

MARS AS VIEWED BY MARINER 9

MARS

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9

Wind-Shaped Features

Mariner 9 convincingly demonstrated that wind is the dominant agent of erosion and sedimentation on Mars. In addition to the great dust storm of 1971, a wide variety of features that can be ascribed to wind activity were found. Unlike craters on the Moon (which lacks an atmosphere) the craters on Mars show the effects of both eolian erosion and deposition. Most craters tend to have flatter floors and less distinguishable surrounding ejecta blankets. Others appear to have been once buried and are now being exhumed by wind action. The equatorial regions of Mars appear to be areas where wind erosion predominates over deposition. This can be seen in numerous examples of streamlined canoe-shaped hills, fluted cliff faces, along with multitudinous parallel grooves on the surface of the flat plains. Similar appearing features are found only in the most rainless and wind-swept deserts of the Earth. (See "Similarities: Mars, Earth, and Moon.") The midlatitude and polar regions appear on the other hand to be areas where deposition of fine wind-blown material predominates. These deposits produce vast almost featureless plains that bury earlier craters and volcanic flows.

The changes in the surface markings of Mars have been a puzzle to telescopic observers for generations. Many elaborate hypotheses have been invented to explain these in terms of vegetation, volcanic activity, or chemical changes. Mariner 9 has shown that almost all the

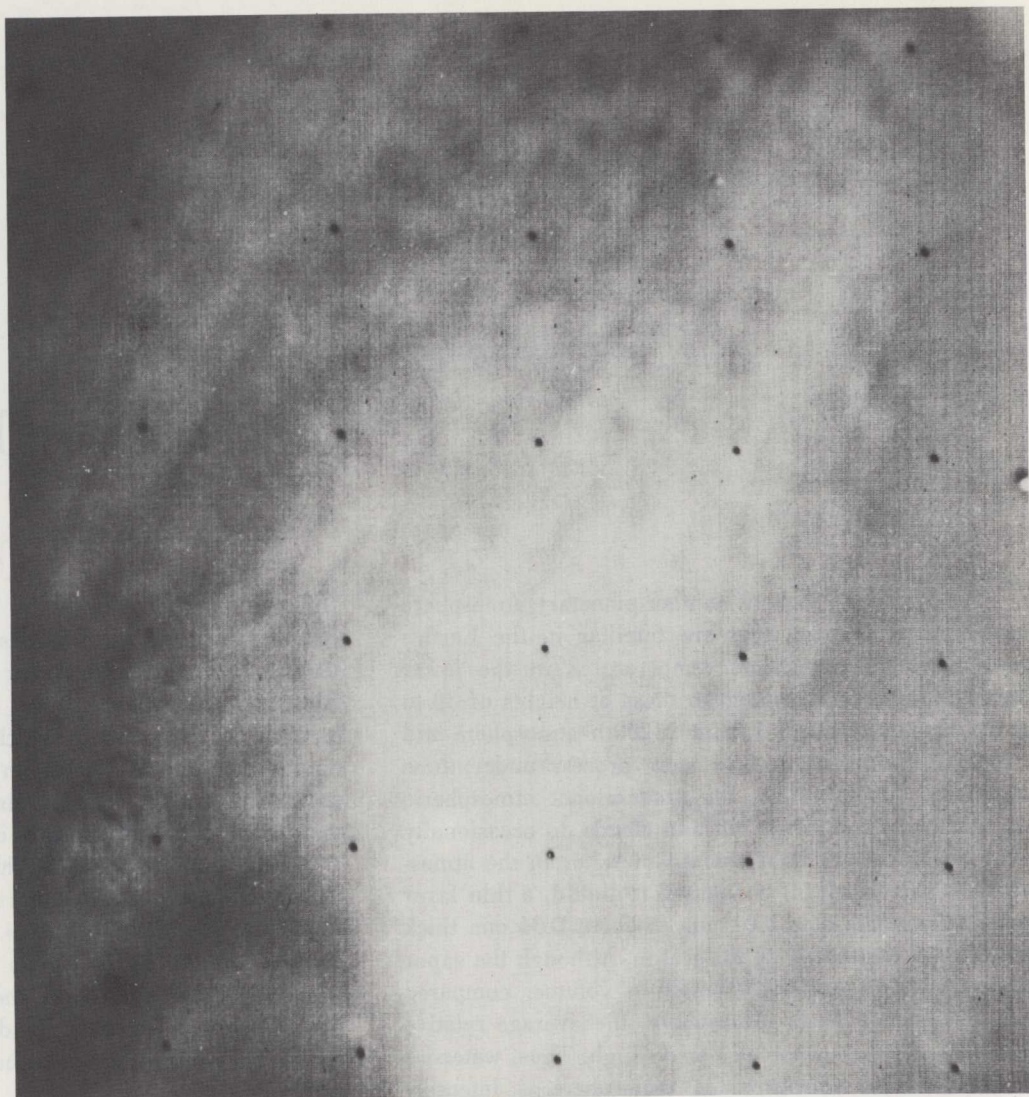
surface markings can be explained by wind activity. Many of the abundant light and dark streaks are associated with craters and other topographic features. These frequently merge into broader mottled patterns that at the telescope would have appeared to be continuous dark patches.

During the Mariner 9 mission some of the streaks actually changed shape and position indicating that they are superficial. (See "Changing Features.") One explanation is that the light areas are zones of deposition of recent dust and fine sand. The dark areas are zones of somewhat coarser and darker material where dust and sand have been removed or were simply not deposited. The same situation prevails in terrestrial deserts in the lees of topographic obstacles. Some of the dark areas in the floors of craters, on the other hand, proved to be large dune fields, further convincing evidence for the dynamic role of the wind on Mars. We now know that the wind is currently sculpturing the surface of Mars, removing silt and clay from some areas and redepositing it in others. As will be seen in other sections of this book, fluvial and glacial activity also have taken place. Thus primarily because of its atmosphere, however tenuous, Mars as had been surmised from the early telescopic observations to more closely resemble the Earth than does the Moon.—J. F. McCauley

13 of Mars

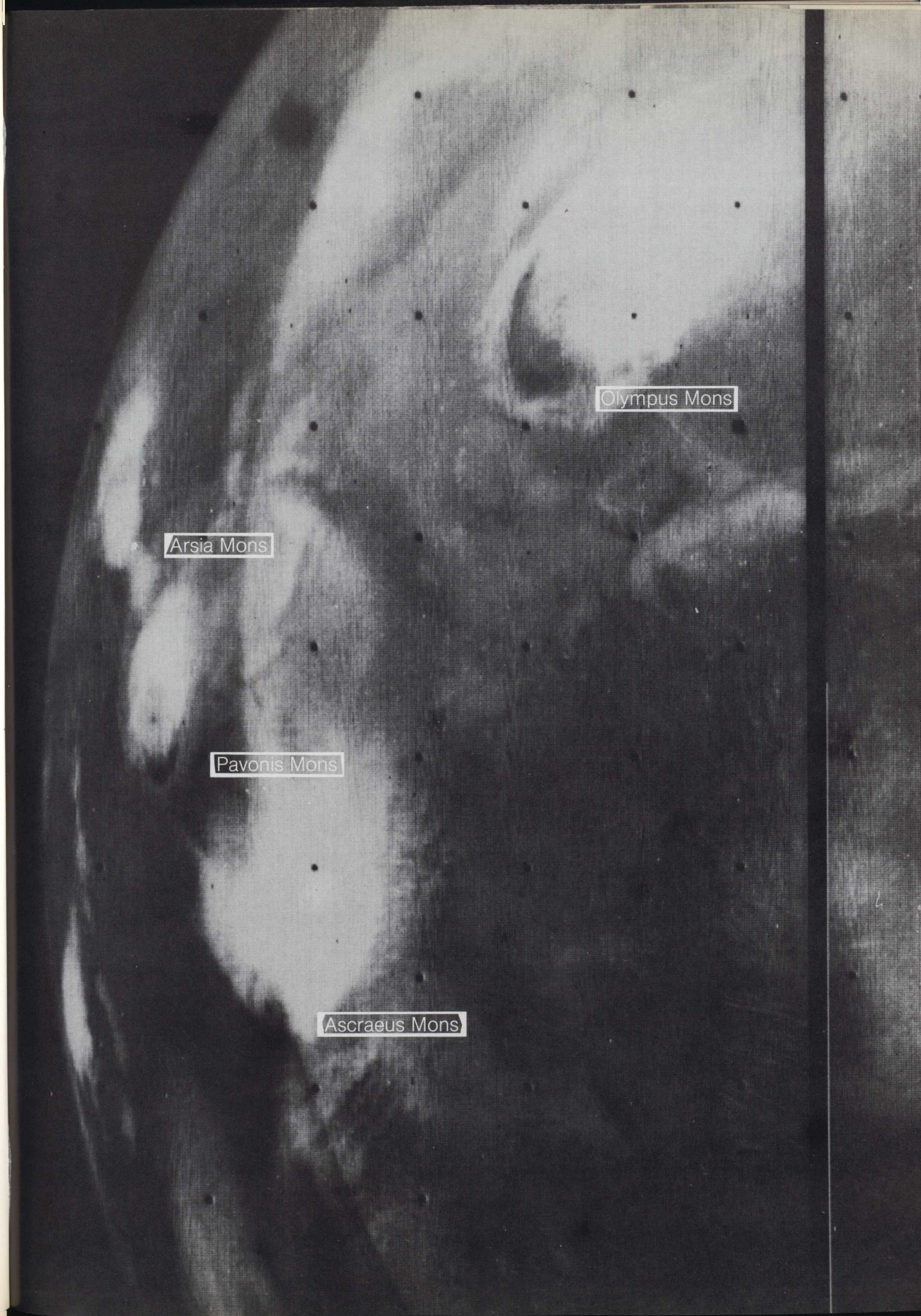
all heights in the atmosphere. The clouds are seen as bright white patches against the dark background of the Martian surface. The clouds are seen in the northern hemisphere of Mars, where the temperature is relatively high. The clouds are seen in the northern hemisphere of Mars, where the temperature is relatively high. The clouds are seen in the northern hemisphere of Mars, where the temperature is relatively high.

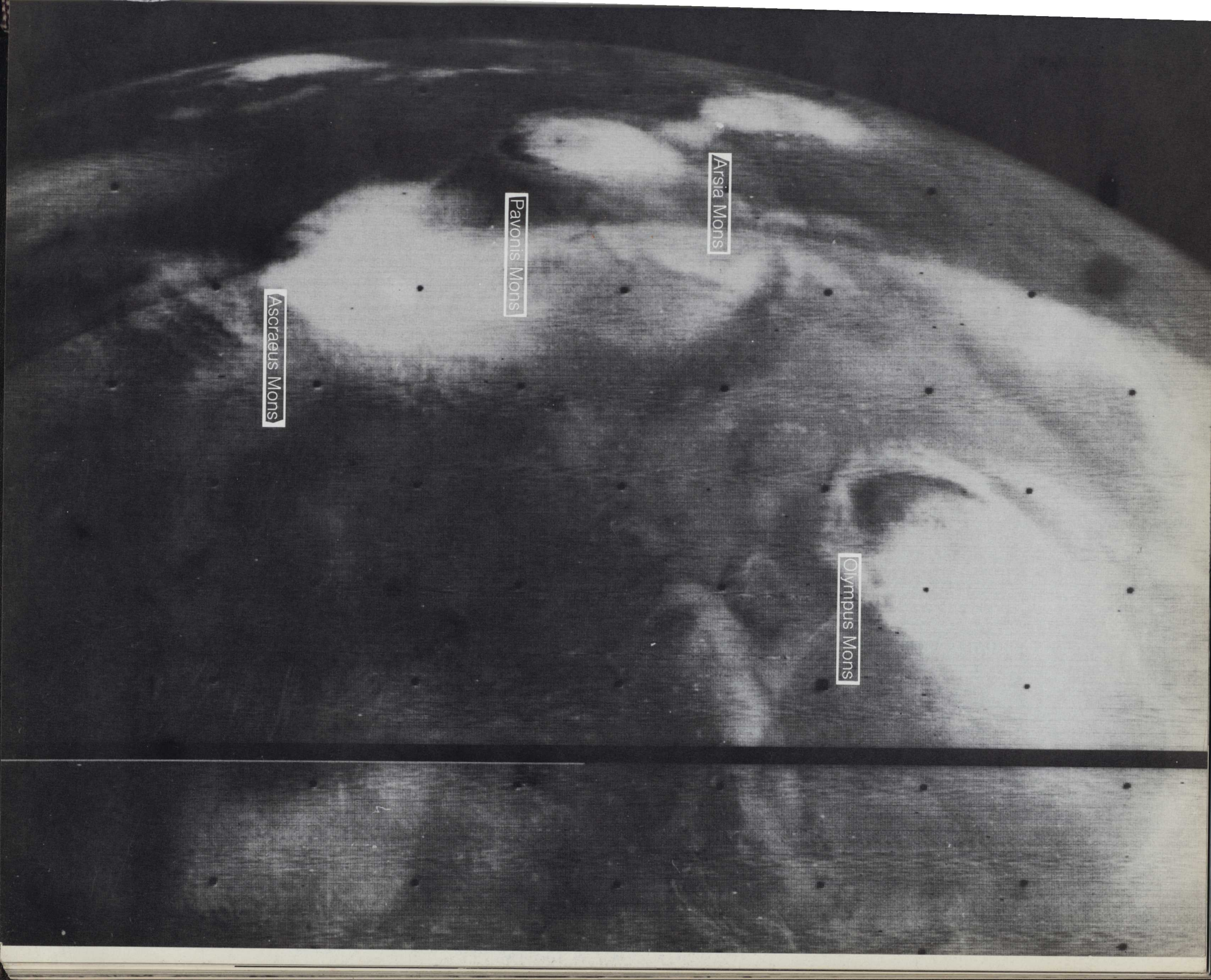
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(19°N, 111°W; MTVS 4098-82)
(14°N, 110°W; MTVS 4098-78)

Some of the last photos received from Mariner 9 showed extensive cloud activity near the largest volcanoes on Mars (right). A high resolution picture (above) of Ascraeus Mons acquired at the same time showed cells suggesting convection, and the infrared spectrometer identified the clouds as water ice. They appeared to be relatively low, and were probably caused by air cooling as it moved up the slope of the volcano, but exchange of water vapor with the ground or even volcanic venting could also be involved.—B. A. Smith





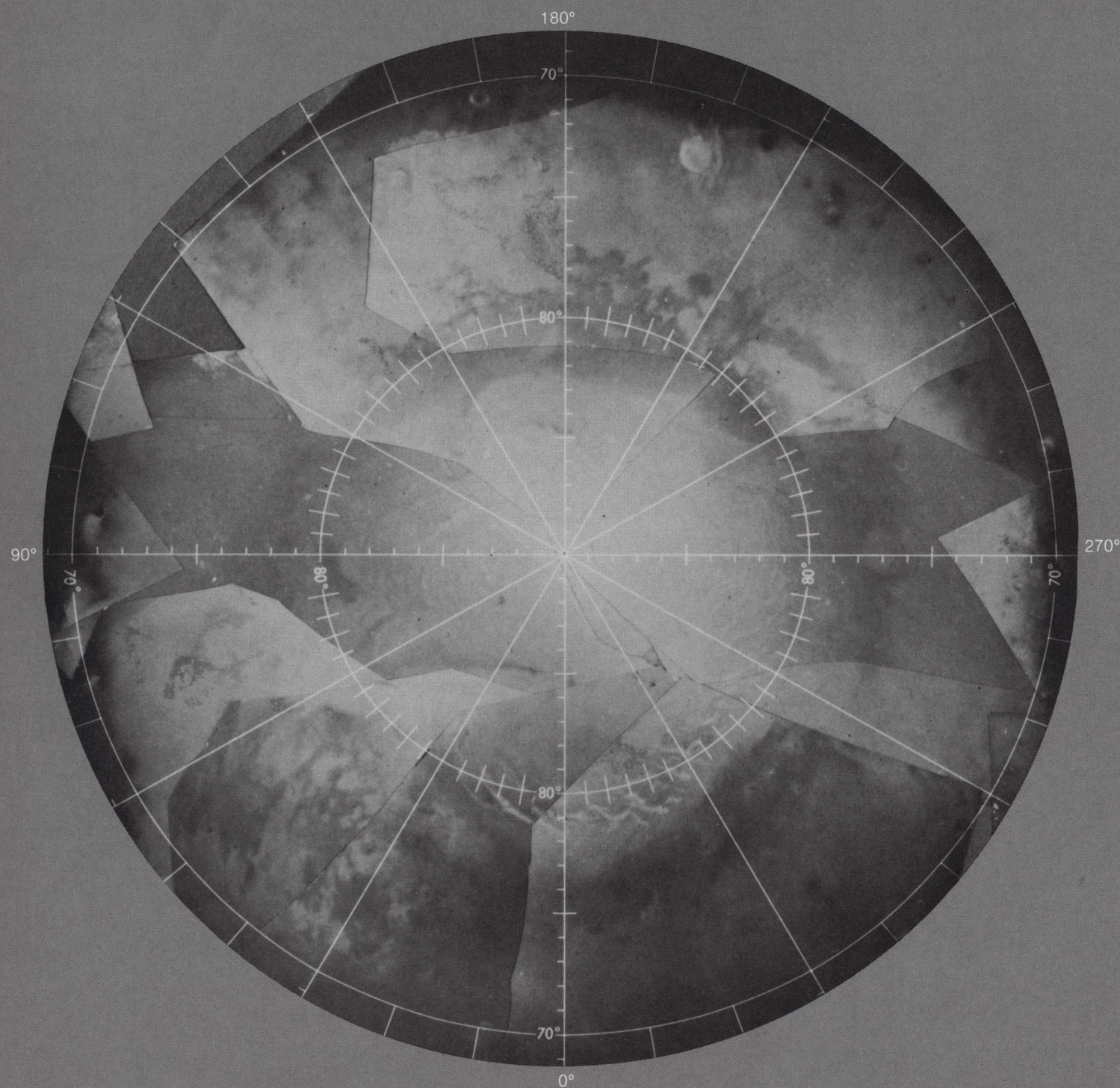
Arsia Mons

Pavonis Mons

Ascraeus Mons

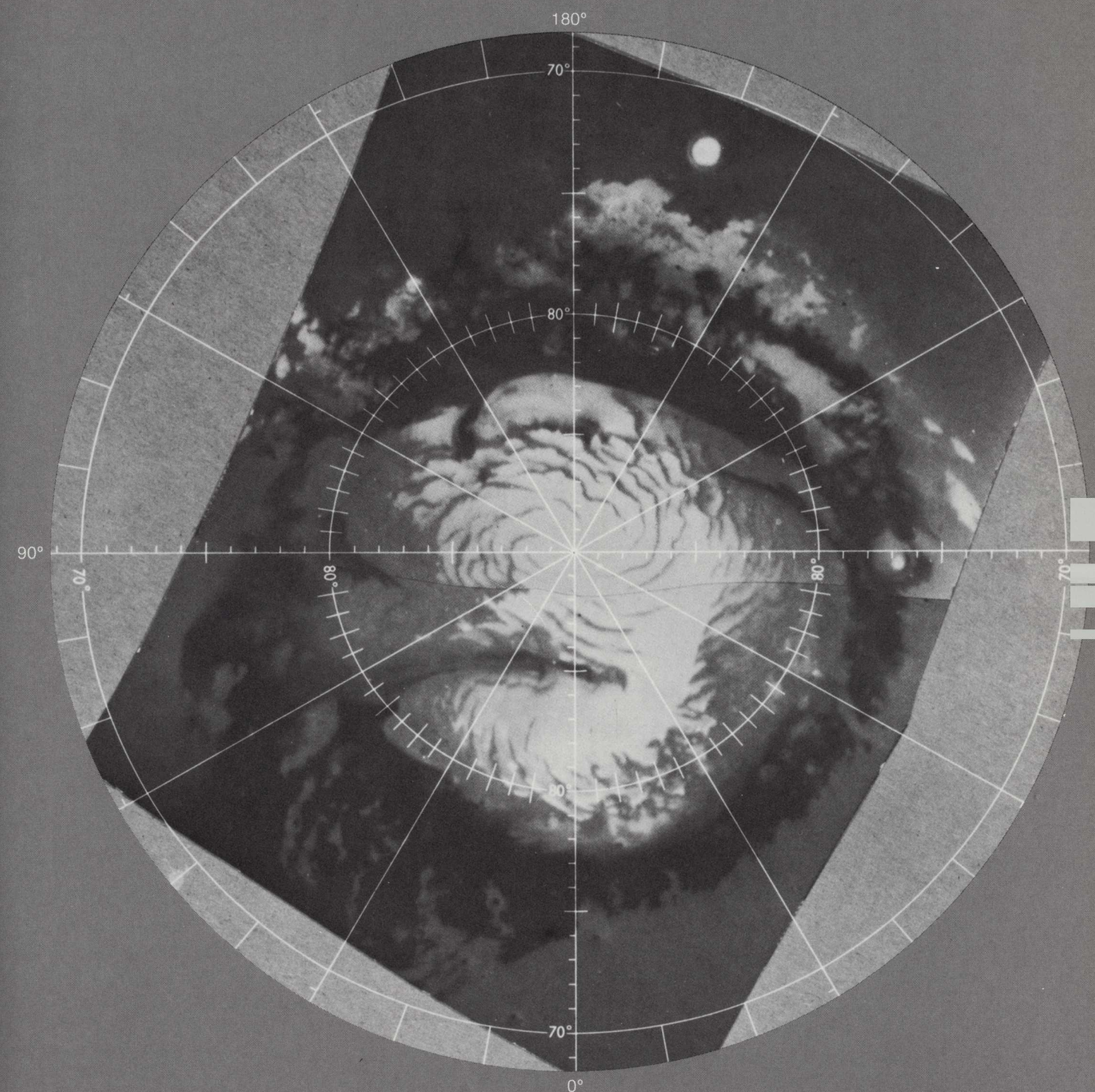
Olympus Mons

NORTH
POLAR REGION
AUGUST 1972



The frost in the north polar region is shown above covering a region about 2700 km wide about five or six martian weeks after the vernal equinox (August 1972) and at right when nearing its minimal extent approximately two weeks after the summer solstice (October 1972). The frost cover had a peculiar polygonal shape that became very pronounced during the last stages of recession of the cap. It is more likely to

NORTH
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OCTOBER 1972



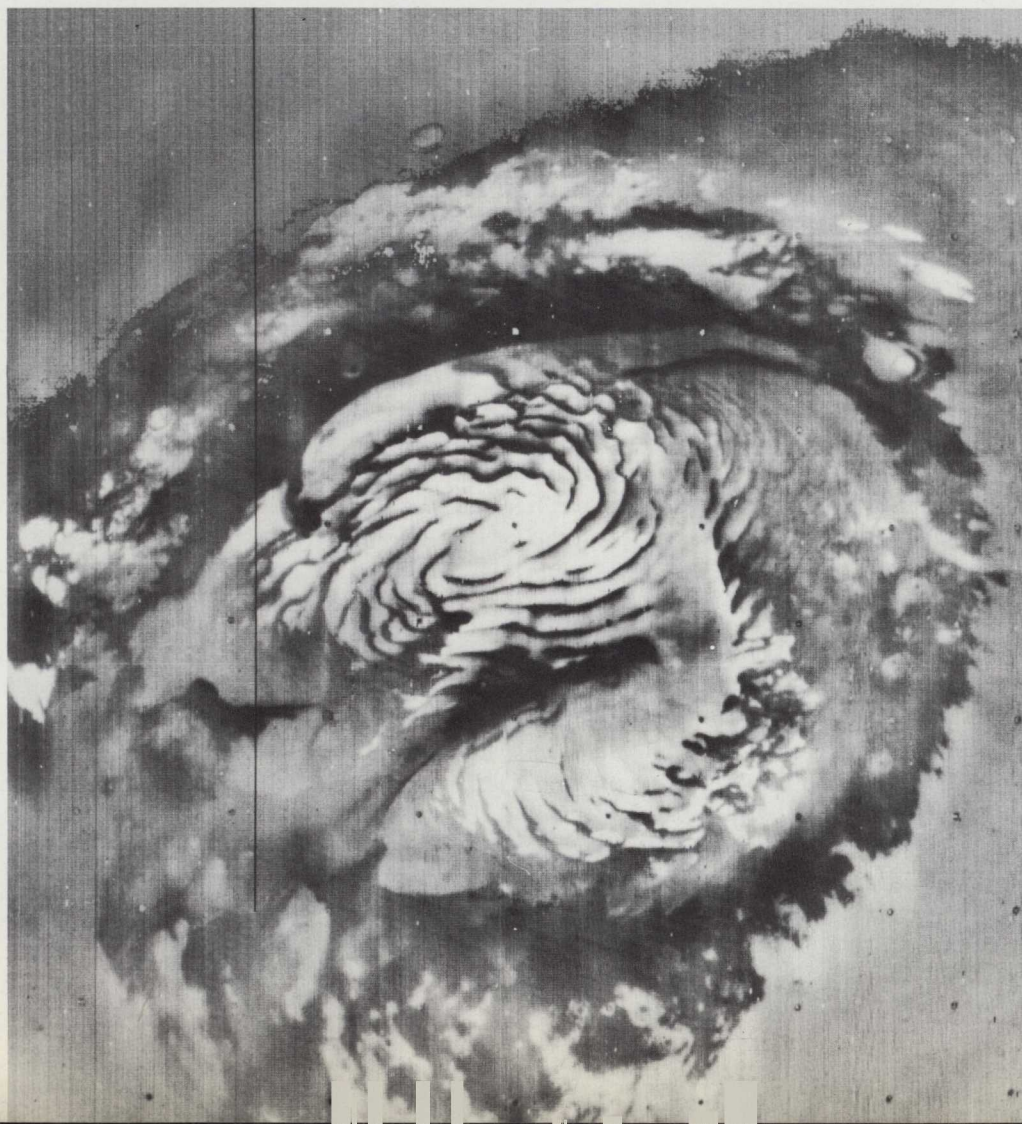
have resulted from regional phenomena than from local scarps or ridges. Regional textural alignments could have been induced by stable wind patterns. Note the crater at 73°N, 198°W in the mosaic at right. It trapped and shielded frost from the Sun, leaving a large patch on its floor.—L. A. Soderblom

(85°S, 355°W; IPL 1312/023810, 7352/184744)

From November until March the south polar cap was in the late stages of its retreat, shrinking to a residual cap about 6° in diameter. The conspicuous curvilinear markings seen as bright bands in 1969 by Mariner 7, defrosted early in 1971 to become the dark bands shown here. These high resolution photographs were taken 110 days apart by Mariner 9. In the initial stages of its retreat the windows in the cap continually changed, but by early 1971 they became fixed and unchanging. The dark features are bare ground, where ice has evaporated from sun-facing slopes. The permanent cap probably contains substantial water, if it is not all water, because a permanent mass of frozen CO₂ would collect water even from Mars' dry atmosphere. The width shown in each photograph is about 100 km.—L. A. Soderblom

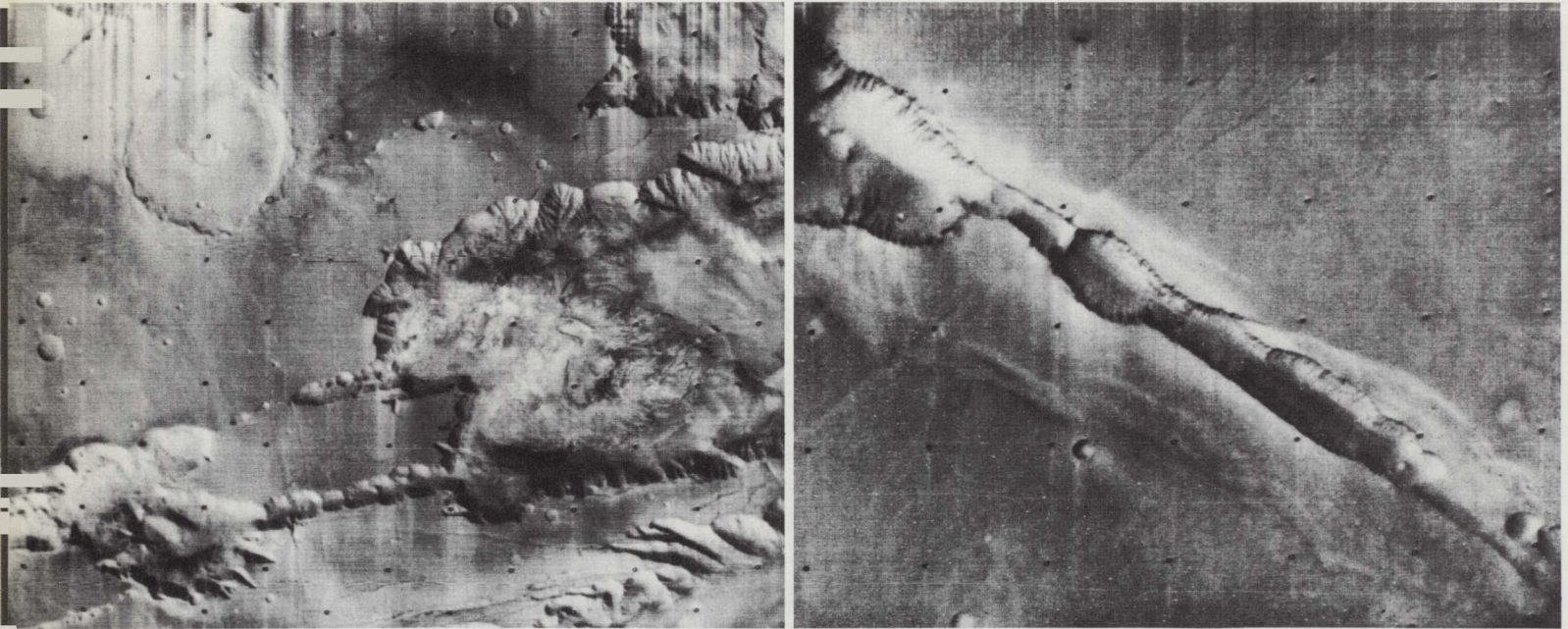
(89°N, 200°W; MTVS 4297-47)

The martian north polar frost cap approached its minimal extent about one-half martian month after summer solstice on October 12, 1972. The cap is about 1000 km across. Its topography and the curved patterns in the interior of the frost cap are interpreted as a series of stacked, slightly concaved plates, the upper one of less areal extent, with edges that have been smoothed and modified. The individual plates may consist of from 20 to 40 separate layers, with an aggregate thickness of perhaps one kilometer. The outline of the residual cap and configuration of the interior markings arise from the frostfree Sun-facing slopes along which layers outcrop. A dark collar of rougher textured terrain surrounds the smoother polar-layered sedimentary complex localized in the central regions of both poles.—L. A. Soderblom



(5°S, 77°W; IPL 1628/204400)

A blunt-ended trough (left) in Valles Marineris, Ophir Chasma, was captured in this magnificent picture, the width of which covers about 400 km. Swirl pattern on the floor of the trough may reflect outcrop of dissected floor deposits. Smaller troughs and lines of pits extending westward from the headwall suggest initiation of troughs along fractures or structures in crust.—R. P. Sharp

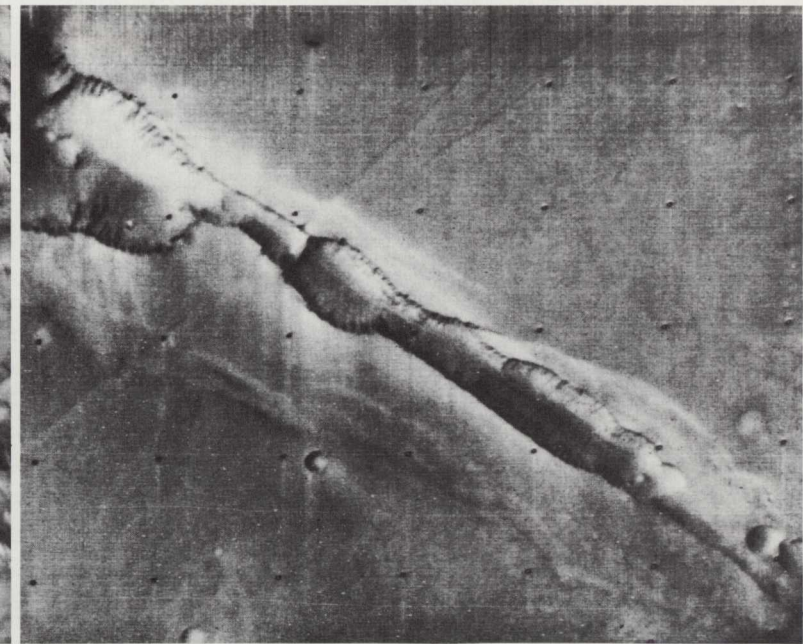


(13°S, 110°W; IPL 1348/223600)

The pits (above) at the right of this canyon suggest one possible method of enlargement of the canyons by collapse and drainage of surface material into what must be a cavernous or porous subsurface. Thus the troughs may expand along lines of these pits as well as by erosion of the walls as seen in the vertical chutes here and in the other numerous examples of wall erosion seen in this section. This picture is about 40 km in width.—J. W. Allingham

(22°S, 254°W; MTVS 4295-79)

These box canyons (right), in Hesperia Planum, display parallel trends that suggest they may have developed along fractures. They were clearly formed before the large number of local small cratering events.—D. B. Potter

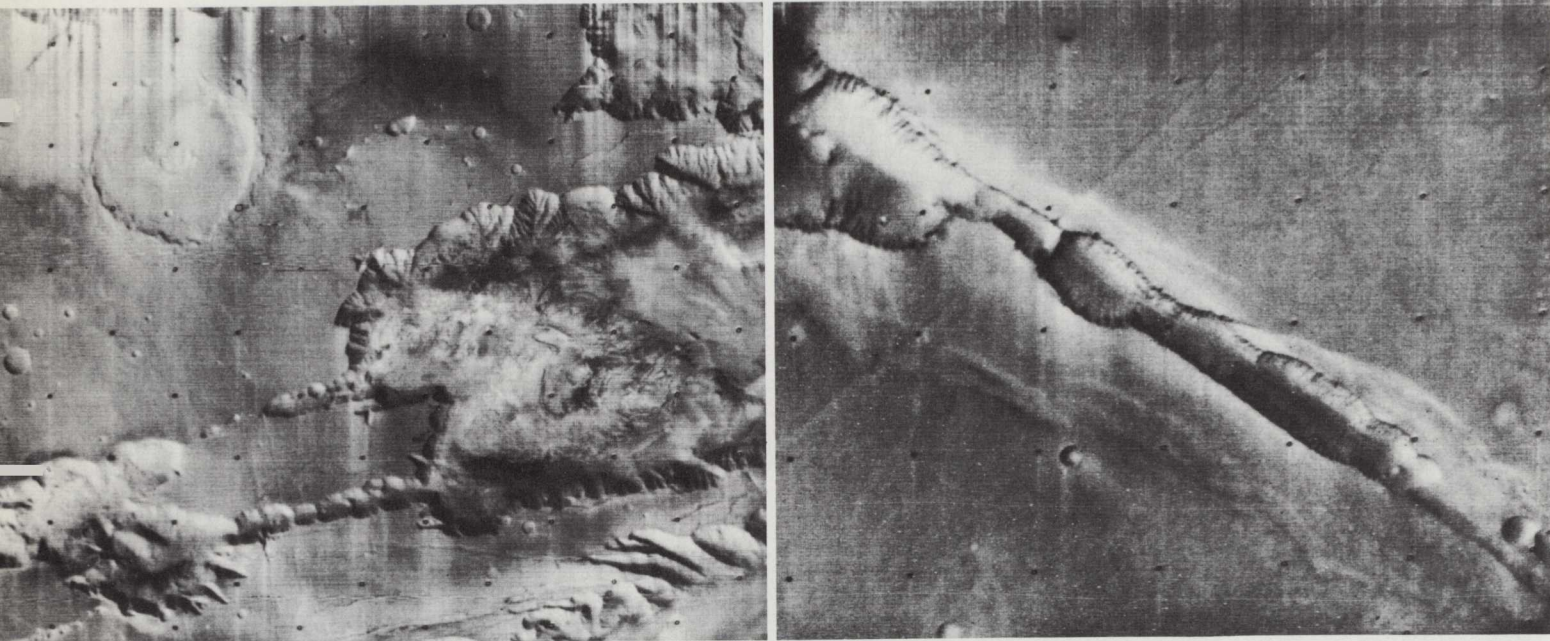


(13°S, 110°W; IPL 1348/223600)

... at the right of this ... with the ...

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